

RAKE RECEIVING APPARATUS FOR DIRECT SEQUENCE CODE DIVISION MULTIPLE ACCESS SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a code division multiple access (CDMA) system, and more particularly to a rake receiving apparatus used in communication systems using a direct sequence CDMA (DS/CDMA) system.

2. Description of the Prior Art

Generally, such a rake receiving apparatus is known to provide an improvement in performance as compared to cases wherein a single demodulator is used. The rake receiving apparatus operates to detect the phases of pseudo noise (PN) codes of signals respectively corresponding to multipaths by use of a searcher. The signals from the multipaths are demodulated in corresponding independent demodulators by use of a plurality of demodulating fingers as receivers, corresponding in number to the multipaths, respectively. The results obtained from the receivers after the demodulation are coupled together in a combiner to extract desired timing information and demodulated data. Thus, the rake receiving apparatus can obtain an improvement in performance, as compared to cases using a single demodulator.

Referring to FIG. 1, a conventional arrangement of such a rake receiving apparatus is illustrated. As shown in FIG. 1, the rake receiving apparatus includes a single searcher, a plurality of demodulating fingers and a post-processing combiner (adapted to extract demodulation data, timing information and frequency information). In this rake receiving apparatus, the searcher first searches for the phases of PN codes corresponding to multipaths. Based on the result of the operation of the searcher, the demodulating fingers carry out their demodulation operations. The demodulating fingers operate individually to demodulate signals associated therewith. The combiner combines the results of the modulation operations respectively carried out in the demodulating fingers, thereby extracting required data and timing information. Since each finger must execute the whole procedure revived for a reverse sequence process, such a rake receiving apparatus using N receivers achieves an improvement in performance as compared to the demodulating method using a single receiver. In this case, however, there is a problem in that the complexity of hardware increases N times or above.

Meanwhile, systems with as fixed number of fingers involve a problem in that they can not demodulate signals from multipaths which are more than the given number of fingers.

SUMMARY OF THE INVENTION

Therefore, an object of the invention is to solve the above-mentioned problems encountered in the prior art and to provide a rake receiving apparatus used in communication systems using a DS/CDMA system, which is capable of not only greatly reducing the complexity of its demodulators, but also having a freedom enabling a combining of all signals from multipaths.

In accordance with the present invention, this object is accomplished by providing a rake receiving apparatus for a direct sequence code division multiple access communication system comprising: a radio frequency receiving unit for receiving a radio frequency signal via an antenna and converting the received radio frequency signal into an

intermediate frequency signal; analog/digital converting means for converting the analog signal, which is the intermediate frequency signal from the radio frequency receiving unit, into a digital signal; digital down-converting means for frequency-down-converting the digital signal received from the analog/digital converting means into a baseband signal; sample delay means for receiving the output signal from the digital down-converting means, and sequentially outputting the receiving output signal while delaying it a predetermined time interval; first pseudo noise code generating means for generating pseudo noise codes and outputting them; searching means for receiving the digital signal from the analog/digital converting means and the pseudo noise codes from the first pseudo noise code generating means, thereby outputting pseudo noise code phases respectively corresponding to multipaths; combiner controlling means for receiving the output signal from the searching means, thereby outputting a signal adapted to select those, to be combined together, of the signals sequentially output from the sample delay means; sample selecting means for receiving the signals sequentially output from the sample delay means as well as the output signal from the combiner controlling means and selectively outputting the signals received from the sample delay means based on the signal received from the combiner controlling means; a combiner for receiving the signals selectively output from the sample selecting means and combining them; second pseudo noise code generating means for receiving the output signal from the combiner controlling means, thereby generating pseudo noise codes; demodulating means for receiving the output signal from the second pseudo noise code generating means as well as the output signal from the combiner means, thereby demodulating data and outputting the demodulated data; and synchronization tracking means for receiving the output signal from the second pseudo noise code generating means as well as the output signal from the combiner means, thereby recovering a synchronization of the pseudo noise codes generated from the first pseudo noise generating means.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and aspects of the invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

FIG. 1 is a block diagram illustrating a conventional rake receiving apparatus;

FIG. 2 is a block diagram illustrating a binary phase shift keying (BPSK) rake receiving apparatus in accordance with an embodiment of the present invention;

FIG. 3 is a block diagram illustrating a quadrature phase shift keying (QPSK) rake receiving apparatus in accordance with another embodiment of the present invention;

FIG. 4 is a block diagram illustrating a rake receiving apparatus in accordance with another embodiment of the present invention;

FIG. 5 is a block diagram illustrating a searcher according to an embodiment of the present invention;

FIG. 6 is a block diagram illustrating a searcher according to another embodiment of the present invention; and

FIG. 7 is a graph depicting the result of a computer simulation carried out to verify the performance of the rake receiving apparatus according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 2 illustrates a BPSK rake receiving apparatus in accordance with an embodiment of the present invention.